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# PATENT ABSTRACTS OF JAPAN

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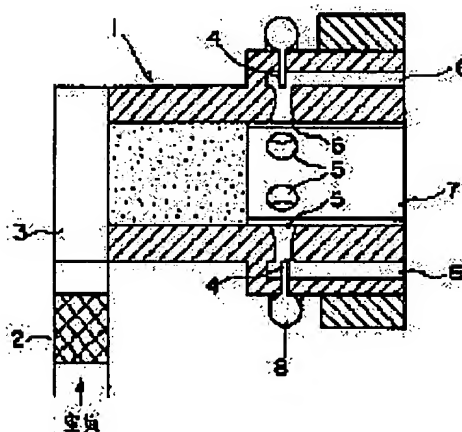
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## (54) HEAT STORAGE TYPE LOW-NOX BURNER

### (57)Abstract:

**PURPOSE:** To enable suction of a large quantity of combustion exhaust gas in a heating furnace and thereby to enable attainment of low NOx by a method wherein the mixture of fuel and vapor is jetted from nozzles to venturi tubes of a burner part in a heat storage type burner.

**CONSTITUTION:** A heat storage type burner 1 is constructed to be in an exhaust gas recirculation system and supply of air for combustion from an air intake 3 and exhaust of a combustion exhaust gas are conducted through a heat storage body 2. The combustion exhaust gas in a heating furnace is sucked through recirculation ducts 6 and mixed in a burner part. In this case, venturi tubes 5 are attached to the burner part and nozzles 4 jetting the mixture of fuel and vapor to the venturi tubes 5 are disposed in this part. Moreover, the combustion exhaust gas in the heating furnace is sucked and made a driving source of the venturi tubes 5. In other words, a negative pressure is brought forth in the venturi tubes 5 with jetting from the nozzles 4 and thereby the combustion exhaust gas in the heating furnace is sucked through the exhaust gas recirculation ducts 6. According to this constitution, reduction of NOx can be facilitated.



## LEGAL STATUS

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CLAIMS

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[Claim(s)]

[Claim 1] The accumulation formula low NO<sub>x</sub> burner characterized by forming a venturi tube in the burner section, preparing the nozzle which injects the mixture of fuel and a steam to this venturi tube in the accumulation formula burner of an exhaust gas recirculating system which discharges supply and the combustion gas from a burner of the combustion air to a burner through a heat-regenerative element, and which attracts the combustion gas in a furnace through an exhaust gas duct, and is mixed in the burner section on the other hand, attracting the combustion gas in a furnace, and considering as the driving source of a venturi tube.

[Claim 2] In the accumulation formula burner of an exhaust gas recirculating system which discharges supply and the combustion gas from a burner of the combustion air to a burner through a heat-regenerative element and which attracts the combustion gas in a furnace through an exhaust gas duct, and is mixed in the burner section on the other hand Form a venturi tube in the burner section and the nozzle which injects only a steam to this venturi tube is prepared. The accumulation formula low NO<sub>x</sub> burner which attracts the combustion gas in a furnace with this venturi tube, considers as the driving source of a venturi tube, and is characterized by preparing a combustion nozzle in a periphery side outside opening of a burner, and on the other hand injecting fuel in a direct furnace through this combustion nozzle.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[Industrial Application] It is related with the direct-fired system accumulation burner which obtains the exhaust gas of low NOx used for the accumulation type police box combustion system used for a steel heating furnace etc.

[0002]

[Description of the Prior Art] Recently, the heating furnace using the burner of an accumulation formula is used in many fields. The accumulation unit accompanied by continuation movement of the heat for heating beforehand the combustion air into which it flows for pulling out and carrying out accumulation of the heat to these heating furnaces from the elevated-temperature combustion excretions as exhaust gas is prepared.

[0003] As a trouble about the above-mentioned accumulation system of the former, it is N2. There is extremely high NOx concentration which exists inevitably like the case where the united fuel is used, in the combustion excretions produced as a result of the extreme elevated-temperature preheating of air and a flame temperature. Consequently, since the conventional accumulation system could not suit reduction of these NOx, development of a new method was desired. The method of suppressing generation of NOx using an accumulation system as shown in drawing 4 is indicated by JP,2-10002,A as one of them. Namely, it is the method of suppressing generation of NOx in the lot of the accumulation burner of form which has the accumulation bed prepared in order to heat the supplied combustion air which pulls out heat by turns from the exhaust gas which came from the furnace, and passes through that. Pull out elevated-temperature exhaust gas from a furnace, and inject a gas stream to this exhaust air gas stream, and some elevated-temperature exhaust gas is made to accompany into the this injected gas stream. It is the method of making a burner room pass the gas stream and the company section of elevated-temperature exhaust gas which were injected, mixing the combustion process in a burner room in this elevated-temperature exhaust gas portion, and suppressing generation of NOx by this.

[0004] It has the lot of 2 accumulation burners 14a and 14b. the [ the 1st which this accumulation system 10 left in drawing 4 , and ] -- each burners 14a and 14b In each burners 14a and 14b which suited so that it might have the combustion chamber 12 for mixing the preheating combustion-air style supplied from the accumulation beds 18a and 18b combined with fuel and each burners 14a and 14b and might operate periodically an exhaust air gas stream -- a furnace -- coming out -- the 2nd -- while flowing to accumulation bed 18b which passed the burner 14b room and was connected to this 2nd burner 14b, 1st burner 14a is accumulation burner equipment of the form in the combustion state of turning elevated-temperature gas to the interior of a furnace In addition, in a combustion blower and 22, an air valve and 24 show an exhaust valve and 27 shows [ 16 / a combustion air/flueway, and 20 ] a control valve.

[0005] And the burner as shown in drawing 5 as an example of a mode is indicated. Drawing 5 has a means by which a means to suppress generation of NOx introduces a part of fuel nozzle and combustion air into the field of the burner which touches a fuel nozzle directly, and has the burner equipped with a means to introduce the remainder of a combustion air to the upstream of a fuel nozzle further. In this burner, the recirculation-of-exhaust-gas duct 100 of 98 or 6 venturi tubes of six fuel nozzles [ 96 or 6 ] is attached in the air-intake 94 and the burner 90 equipped with the heat-regenerative element 92. This burner 90 is prolonged in the furnace room through opening 101. the fuel nozzle 96 of this centripetalism-arrangement -- all -- alike -- therefore -- fuel -- the hole of the spreading shape of each cylinder in burner refractories -- a burner is supplied through the venturi tube 98 which is a field

Injection of the high-pressure fuel from a fuel nozzle 96 produces a negative pressure field in a venturi tube 98, and it attracts it so that this negative pressure field may return furnace gas from a furnace room to a combustion zone through the mixed duct 100. In short, this equipment is equipment using only fuel as a driving source at the time of installing a venturi tube 98 in the burner section, and attracting the combustion gas in a furnace. Moreover, conventionally, in the burner, for the cure against low NOx, the steamy injection nozzle was installed in the burner core combustion-air side, and the steam was injected.

[0006]

[Problem(s) to be Solved by the Invention] When the direct-fired system accumulation burner described above is used for the heating furnace of steel materials, the highest of the degree of furnace temperature becomes about 1300 degrees C. If the cure against low NOx is not performed on this condition, the NOx concentration of an exhaust gas will become also more than 1000 ppm (O2:11%). Therefore, in order to lower the NOx concentration of an exhaust gas, the exhaust gas recirculating system has been developed and adopted. However, by the method of this exhaust gas recirculating system, the NOx concentration of an exhaust gas fell only by the 200 ppm (O2:11%) grade, but when to lower to the exhaust-gas NOx criteria concentration of 100 ppm or less was demanded like Japan, attaining this had the trouble of being difficult. This invention enables it to cancel the above-mentioned trouble, and aims at offering the direct-fired system accumulation low NOx burner which may lower the NOx concentration of an exhaust gas to 100 ppm or less of criteria.

[0007]

[Means for Solving the Problem] this invention attains the purpose by using only the mixture or the steam of fuel and a steam in the accumulation formula burner of the exhaust gas recirculating system which mixes the combustion gas in a furnace in the burner section as a driving source at the time of installing a venturi tube in the burner section and attracting the combustion gas in a furnace. Namely, the 1st invention discharges supply and the combustion gas from a burner of the combustion air to a burner through a heat-regenerative element. In the accumulation formula burner of an exhaust gas recirculating system which attracts the combustion gas in a furnace through an exhaust gas duct, and is mixed in the burner section on the other hand In order to form a venturi tube in the burner section, to prepare the nozzle which injects the mixture of fuel and a steam to this venturi tube and to attract the combustion gas in a furnace, it is the accumulation formula low NOx burner characterized by considering as the driving source of a venturi tube. The 2nd invention is an accumulation formula low NOx burner characterized by forming a venturi tube in the burner section, preparing the nozzle which injects only a steam to this venturi tube, considering as the driving source of a venturi tube, attracting the combustion gas in a furnace with this venturi tube in the accumulation formula burner of an exhaust gas recirculating system same as the above, preparing a combustion nozzle in a periphery side outside opening of a burner on the other hand, and injecting fuel in a direct furnace through this combustion nozzle.

[0008]

[Function] In a direct-fired system accumulation burner, in order to lower the NOx concentration of an exhaust gas, it is necessary to lower the maximum temperature of a combustion flame. It is necessary to make an exhaust gas circulating load for that increase more to the conventional method. On the other hand, the venturi tube was formed in the burner section, the nozzle which injects the mixture of fuel and a steam to this venturi tube was prepared, the suction force increased and the exhaust gas re-circulating load increased the 1st of this invention because the increase of the fluid flow for a venturi tube drive and the rate of flow increase since it decided to use the mixture of fuel and a steam as a driving source of a venturi tube. Furthermore, simultaneously, compared with an about 1600-degree C burner flame, by the steam of about 200 degrees C of lows of temperature being far injected together with fuel, the maximum-temperature section of a flame is cooled and temperature falls to 1500 degrees C or less. The NOx concentration of a burner exhaust gas can make it fall sharply to or less about 1 / 10 compared with the time of conventional NOx un-coping with it by two operations above.

[0009] moreover, a way whose artificers do uniform mixture of a steam and the fuel, and inject them in a flame rather than the method of installing a steamy injection nozzle in a combustion-air side like the conventional technology as a result of experimenting in many as the effective steam jet method for NOx concentration reduction is effective -- knowledge -- the bottom In order that all fuel may contribute to combustion, the injected steam spreads round the flame section uniformly, and the fact of lowering a flame temperature effectively is cited as this reason. On the other hand, when a steamy injection nozzle is installed in a combustion-air side, in order that all the combustion airs sent to the burner may not contribute to combustion, a flame temperature does not fall compared with the case where the mixture of

fuel and a steam is used, and it is not effective for NOx concentration reduction. Moreover, since fuel and a steam are blown from the same nozzle when the mixture of fuel and a steam is used, there is also an advantage that it is not necessary to prepare a nozzle, separately.

[0010] Furthermore, in order to give the low NOx effect according to the slow combustion of the burner itself in the 2nd of this invention, In order to reduce NOx concentration further in the burner which had the fuel nozzle arranged so that fuel may be blown into a direct furnace, By using for the drive of the venturi tube for the recirculation of exhaust gas only a steam with a high and pressure and the effect higher than fuel which cools a flame, further, it is cooled by 1450 degrees C or less, and the maximum-temperature section of a flame can reduce NOx concentration more.

[0011]

[Example] Drawing 1 is the side elevation of the accumulation formula low NOx burner which is the example of an embodiment of this invention. drawing 1 -- setting -- 1 -- for an air intake and 4, as for a venturi tube, 6 recycle duct, and 7, a fuel nozzle and 5 are [ a burner and 2 / a heat-regenerative element and 3 / opening and 8 ] steam pipes In this accumulation formula low NOx burner, the recirculation-of-exhaust-gas duct 6 of 5 or 6 venturi tubes of six fuel nozzles [ 4 or 6 ] is attached in the air-intake 3 and the burner 1 equipped with the heat-regenerative element 2. The origin of a fuel nozzle 4 is a periphery-like header, attaches a steam pipe 8 here, introduces a steam, and carries out uniform mixture with fuel. Fuel and a steam are supplied to a burner through each venturi tube 5 in the opening 7 of refractories by six fuel nozzles 4. Injection of a fuel and a steam with many flow rates produces a negative pressure field in a venturi tube 5 in the high pressure from a fuel nozzle 4, and this negative pressure field attracts a combustion gas so that it may return from the inside of a furnace to a combustion zone through the recirculation-of-exhaust-gas duct 6.

[0012] In the case of this accumulation formula low NOx burner, the maximum temperature of a combustion flame is lowered by recycle injection of a lot of combustion gases. When this method was applied to the accumulation formula burner of amount of the maximum combustion 800000 kcal/h capacity, that whose NOx was 200 ppm (O2:11%) in the conventional method was able to reduce NOx concentration below to 80 ppm (O2:11%) by mixing with fuel and blowing a steam 8 kg/h on conditions with a degree [ of furnace temperature ] of 1300 degrees C.

[0013] Moreover, drawing 2 is the side elevation of the accumulation formula low NOx burner which is another example of an embodiment of this invention, and drawing 3 is VIII-VIII of drawing 2 . It is the front view of a cross section. In drawing, 9 is a combustion nozzle. Since other signs are the same as that of drawing 1 , explanation is omitted. Fuel is made to inject in a direct furnace by six combustion nozzles 9 in the accumulation formula low NOx burner of this method. Moreover, the nozzle 4 of a venturi tube 5 is made to inject only a steam, and carries out negative pressure generation with a venturi tube 5, and for it, a combustion gas is attracted so that it may return from the inside of a furnace to a combustion zone through the recirculation-of-exhaust-gas duct 6. The maximum temperature of a combustion flame is lowered by circulation of a lot of combustion gases, and steamy injection by making a high-pressure (1 kg/cm<sup>2</sup>) steam into the driving source of a venturi tube 5.

[0014] When this method is applied to the burner of amount of the maximum combustion 800000 kcal/h capacity, on conditions with a degree [ of furnace temperature ] of 1300 degrees C by the conventional method (what does not perform exhaust gas circulation) That whose NOx was 100 ppm (O2:11%) was able to reduce NOx concentration below to 50 ppm (O2:11%) by blowing a high-pressure (1 kg/cm<sup>2</sup>) steam 8 kg/h. 50-80 ppm (O2:11%) and generating of NOx were able to be sharply suppressed for the NOx concentration of an exhaust gas low the above result.

[0015] In addition, the accumulation formula low NOx burner concerning this invention is not limited only to the burner of the form mentioned above, and if it is a self-recirculation-of-exhaust-gas accumulation burner of a radiant-tube formula (indirect heating formula), it can be used by the burner of various types.

[0016]

[Effect of the Invention] It is contributing [ can suppress the NOx concentration of a lot of exhaust gases, such as a steel heating furnace to 50-80 ppm below emission standard concentration (O2:11%), as a result, can use a direct fire accumulation burner with sufficient thermal efficiency also in Japan, and / to productivity ]-by adoption of accumulation formula low NOx burner of this invention, size.

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**TECHNICAL FIELD**

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[Industrial Application] It is related with the direct-fired system accumulation burner which obtains the exhaust gas of low NO<sub>x</sub> used for the accumulation type police box combustion system used for a steel heating furnace etc.

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PRIOR ART

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[Description of the Prior Art] Recently, the heating furnace using the burner of an accumulation formula is used in many fields. The accumulation unit accompanied by continuation movement of the heat for heating beforehand the combustion air into which it flows for pulling out and carrying out accumulation of the heat to these heating furnaces from the elevated-temperature combustion excretions as exhaust gas is prepared.

[0003] As a trouble about the above-mentioned accumulation system of the former, it is N2. There is extremely high NOx concentration which exists inevitably like the case where the united fuel is used, in the combustion excretions produced as a result of the extreme elevated-temperature preheating of air and a flame temperature. Consequently, since the conventional accumulation system could not suit reduction of these NOx, development of a new method was desired. The method of suppressing generation of NOx using an accumulation system as shown in drawing 4 is indicated by JP,2-10002,A as one of them. Namely, it is the method of suppressing generation of NOx in the lot of the accumulation burner of form which has the accumulation bed prepared in order to heat the supplied combustion air which pulls out heat by turns from the exhaust gas which came from the furnace, and passes through that. Pull out elevated-temperature exhaust gas from a furnace, and inject a gas stream to this exhaust air gas stream, and some elevated-temperature exhaust gas is made to accompany into the this injected gas stream. It is the method of making a burner room pass the gas stream and the company section of elevated-temperature exhaust gas which were injected, mixing the combustion process in a burner room in this elevated-temperature exhaust gas portion, and suppressing generation of NOx by this.

[0004] It has the lot of 2 accumulation burners 14a and 14b. the [ the 1st which this accumulation system 10 left in drawing 4 , and ] -- each burners 14a and 14b In each burners 14a and 14b which suited so that it might have the combustion chamber 12 for mixing the preheating combustion-air style supplied from the accumulation beds 18a and 18b combined with fuel and each burners 14a and 14b and might operate periodically an exhaust air gas stream -- a furnace -- coming out -- the 2nd -- while flowing to accumulation bed 18b which passed the burner 14b room and was connected to this 2nd burner 14b, 1st burner 14a is accumulation burner equipment of the form in the combustion state of turning elevated-temperature gas to the interior of a furnace In addition, in a combustion blower and 22, an air valve and 24 show an exhaust valve and 27 shows [ 16 / a combustion air/flueway, and 20 ] a control valve.

[0005] And the burner as shown in drawing 5 as an example of a mode is indicated. Drawing 5 has a means by which a means to suppress generation of NOx introduces a part of fuel nozzle and combustion air into the field of the burner which touches a fuel nozzle directly, and has the burner equipped with a means to introduce the remainder of a combustion air to the upstream of a fuel nozzle further. In this burner, the recirculation-of-exhaust-gas duct 100 of 98 or 6 venturi tubes of six fuel nozzles [ 96 or 6 ] is attached in the air-intake 94 and the burner 90 equipped with the heat-regenerative element 92. This burner 90 is prolonged in the furnace room through opening 101. the fuel nozzle 96 of this centripetalism-arrangement -- all -- alike -- therefore -- fuel -- the hole of the spreading shape of each cylinder in burner refractories -- a burner is supplied through the venturi tube 98 which is a field Injection of the high-pressure fuel from a fuel nozzle 96 produces a negative pressure field in a venturi tube 98, and it attracts it so that this negative pressure field may return furnace gas from a furnace room to a combustion zone through the mixed duct 100. In short, this equipment is equipment using only fuel as a driving source at the time of installing a venturi tube 98 in the burner section, and attracting the combustion gas in a furnace. Moreover, conventionally, in the burner, for the cure against low NOx, the steamy injection nozzle was installed in the burner core combustion-air side, and the steam was injected.

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EFFECT OF THE INVENTION

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[Effect of the Invention] It is contributing [ can suppress the NO<sub>x</sub> concentration of a lot of exhaust gases, such as a steel heating furnace to 50-80 ppm below emission standard concentration (O<sub>2</sub>:11%), as a result, can use a direct fire accumulation burner with sufficient thermal efficiency also in Japan, and / to productivity ]-by adoption of accumulation formula low NO<sub>x</sub> burner of this invention, size.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] When the direct-fired system accumulation burner described above is used for the heating furnace of steel materials, the highest of the degree of furnace temperature becomes about 1300 degrees C. If the cure against low NOx is not performed on this condition, the NOx concentration of an exhaust gas will become also more than 1000 ppm (O<sub>2</sub>:11%). Therefore, in order to lower the NOx concentration of an exhaust gas, the exhaust gas re-circuit system has been developed and adopted. However, by the method of this exhaust gas re-circuit system, the NOx concentration of an exhaust gas fell only by the 200 ppm (O<sub>2</sub>:11%) grade, but when to lower to the exhaust-gas NOx criteria concentration of 100 ppm or less was demanded like Japan, attaining this had the trouble of being difficult. This invention enables it to cancel the above-mentioned trouble, and aims at offering the direct-fired system accumulation low NOx burner which may lower the NOx concentration of an exhaust gas to 100 ppm or less of criteria.

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MEANS

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[Means for Solving the Problem] this invention attains the purpose by using only the mixture or the steam of fuel and a steam in the accumulation formula burner of the exhaust gas re-circuit system which mixes the combustion gas in a furnace in the burner section as a driving source at the time of installing a venturi tube in the burner section and attracting the combustion gas in a furnace. Namely, the 1st invention discharges supply and the combustion gas from a burner of the combustion air to a burner through a heat-regenerative element. In the accumulation formula burner of an exhaust gas re-circuit system which attracts the combustion gas in a furnace through an exhaust gas duct, and is mixed in the burner section on the other hand In order to form a venturi tube in the burner section, to prepare the nozzle which injects the mixture of fuel and a steam to this venturi tube and to attract the combustion gas in a furnace, it is the accumulation formula low NOx burner characterized by considering as the driving source of a venturi tube. The 2nd invention is an accumulation formula low NOx burner characterized by forming a venturi tube in the burner section, preparing the nozzle which injects only a steam to this venturi tube, considering as the driving source of a venturi tube, attracting the combustion gas in a furnace with this venturi tube in the accumulation formula burner of an exhaust gas re-circuit system same as the above, preparing a combustion nozzle in a periphery side outside opening of a burner on the other hand, and injecting fuel in a direct furnace through this combustion nozzle.

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OPERATION

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[Function] In a direct-fired system accumulation burner, in order to lower the NOx concentration of an exhaust gas, it is necessary to lower the maximum temperature of a combustion flame. It is necessary to make an exhaust gas circulating load for that increase more to the conventional method. On the other hand, the venturi tube was formed in the burner section, the nozzle which injects the mixture of fuel and a steam to this venturi tube was prepared, the suction force increased and the exhaust gas re-circulating load increased the 1st of this invention because the increase of the fluid flow for a venturi tube drive and the rate of flow increase since it decided to use the mixture of fuel and a steam as a driving source of a venturi tube. Furthermore, simultaneously, compared with an about 1600-degree C burner flame, by an about 200-degree C steam with far low temperature being injected together with fuel, the maximum-temperature section of a flame is cooled and temperature falls to 1500 degrees C or less. The NOx concentration of a burner exhaust gas can make it fall sharply to or less about 1 / 10 compared with the time of conventional NOx un-coping with it by two operations above.

[0009] moreover, a way whose artificers do uniform mixture of a steam and the fuel, and inject them in a flame rather than the method of installing a steamy injection nozzle in a combustion-air side like the conventional technology as a result of experimenting in many as the effective steam jet method for NOx concentration reduction is effective -- knowledge -- the bottom In order that all fuel may contribute to combustion, the injected steam spreads round the flame section uniformly, and the fact of lowering a flame temperature effectively is cited as this reason. On the other hand, when a steamy injection nozzle is installed in a combustion-air side, in order that all the combustion airs sent to the burner may not contribute to combustion, a flame temperature does not fall compared with the case where the mixture of fuel and a steam is used, and it is not effective for NOx concentration reduction. Moreover, since fuel and a steam are blown from the same nozzle when the mixture of fuel and a steam is used, there is also an advantage that it is not necessary to prepare a nozzle, separately.

[0010] Furthermore, in order to give the low NOx effect according to the slow combustion of the burner itself in the 2nd of this invention, Since NOx concentration is further reduced in the burner which had the fuel nozzle arranged so that fuel may be blown into a direct furnace, by using for the drive of the venturi tube for the recirculation of exhaust gas only a steam with a high and pressure and the effect higher than fuel which cools a flame, further, it is cooled by 1450 degrees C or less, and the maximum-temperature section of a flame can reduce NOx concentration more.

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EXAMPLE

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[Example] Drawing 1 is the side elevation of the accumulation formula low NOx burner which is the example of an embodiment of this invention. drawing 1 -- setting -- 1 -- for an air intake and 4, as for a venturi tube, 6 recycle duct, and 7, a fuel nozzle and 5 are [ a burner and 2 / a heat-regenerative element and 3 / opening and 8 ] steam pipes In this accumulation formula low NOx burner, the recirculation-of-exhaust-gas duct 6 of 5 or 6 venturi tubes of six fuel nozzles [ 4 or 6 ] is attached in the air-intake 3 and the burner 1 equipped with the heat-regenerative element 2. The origin of a fuel nozzle 4 is a periphery-like header, attaches a steam pipe 8 here, introduces a steam, and carries out uniform mixture with fuel. Fuel and a steam are supplied to a burner through each venturi tube 5 in the opening 7 of refractories by six fuel nozzles 4. Injection of a fuel and a steam with many flow rates produces a negative pressure field in a venturi tube 5 in the high pressure from a fuel nozzle 4, and this negative pressure field attracts a combustion gas so that it may return from the inside of a furnace to a combustion zone through the recirculation-of-exhaust-gas duct 6.

[0012] In the case of this accumulation formula low NOx burner, the maximum temperature of a combustion flame is lowered by recycle injection of a lot of combustion gases. When this method was applied to the accumulation formula burner of amount of the maximum combustion 800000 kcal/h capacity, that whose NOx was 200 ppm (O2:11%) in the conventional method was able to reduce NOx concentration below to 80 ppm (O2:11%) by mixing with fuel and blowing a steam 8 kg/h on conditions with a degree [ of furnace temperature ] of 1300 degrees C.

[0013] Moreover, drawing 2 is the side elevation of the accumulation formula low NOx burner which is another example of an embodiment of this invention, and drawing 3 is VIII-VIII of drawing 2 . It is the front view of a cross section. In drawing, 9 is a combustion nozzle. Since other signs are the same as that of drawing 1 , explanation is omitted. Fuel is made to inject in a direct furnace by six combustion nozzles 9 in the accumulation formula low NOx burner of this method. Moreover, the nozzle 4 of a venturi tube 5 is made to inject only a steam, and carries out negative pressure generation with a venturi tube 5, and for it, a combustion gas is attracted so that it may return from the inside of a furnace to a combustion zone through the recirculation-of-exhaust-gas duct 6. The maximum temperature of a combustion flame is lowered by circulation of a lot of combustion gases, and steamy injection by making a high-pressure (1 kg/cm<sup>2</sup>) steam into the driving source of a venturi tube 5.

[0014] When this method is applied to the burner of amount of the maximum combustion 800000 kcal/h capacity, on conditions with a degree [ of furnace temperature ] of 1300 degrees C by the conventional method (what does not perform exhaust gas circulation) That whose NOx was 100 ppm (O2:11%) was able to reduce NOx concentration below to 50 ppm (O2:11%) by blowing a high-pressure (1 kg/cm<sup>2</sup>) steam 8 kg/h. 50-80 ppm (O2:11%) and generating of NOx were able to be sharply suppressed for the NOx concentration of an exhaust gas low the above result.

[0015] In addition, the accumulation formula low NOx burner concerning this invention is not limited only to the burner of the form mentioned above, and if it is a self-recirculation-of-exhaust-gas accumulation burner of a radiant-tube formula (indirect heating formula), it can be used by the burner of various types.

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[Translation done.]

**\* NOTICES \***

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**DESCRIPTION OF DRAWINGS**

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[Brief Description of the Drawings]

[Drawing 1] It is the side elevation of the accumulation formula low NOx burner which is the example of an embodiment of this invention.

[Drawing 2] It is the side elevation of the accumulation formula low NOx burner which is another example of an embodiment of this invention.

[Drawing 3] Drawing 3 is VIII-VIII of drawing 2 . It is the front view of a cross section.

[Drawing 4] It is explanatory drawing of the side of the conventional accumulation formula burner.

[Drawing 5] It is explanatory drawing of the side of the conventional accumulation formula burner.

[Description of Notations]

- 1 Accumulation Formula Burner
- 2 Heat-regenerative Element
- 3 Air-intake
- 4 Fuel Nozzle
- 5 Venturi Tube
- 6 Recirculation-of-Exhaust-Gas Duct
- 7 Opening
- 8 Steam Pipe
- 9 Combustion Nozzle
- 10 Accumulation System
- 12 Combustion Chamber
- 14 Accumulation Burner
- 16 Combustion Air/Flueway
- 18 Accumulation Bed
- 20 Combustion Blower
- 22 Air Valve
- 24 Exhaust Valve
- 27 Control Valve
- 90 Burner
- 92 Accumulation Bed
- 94 Air-intake
- 96 Fuel Nozzle
- 98 Venturi Tube
- 100 Recirculation-of-Exhaust-Gas Duct
- 101 Opening

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[Translation done.]

\* NOTICES \*

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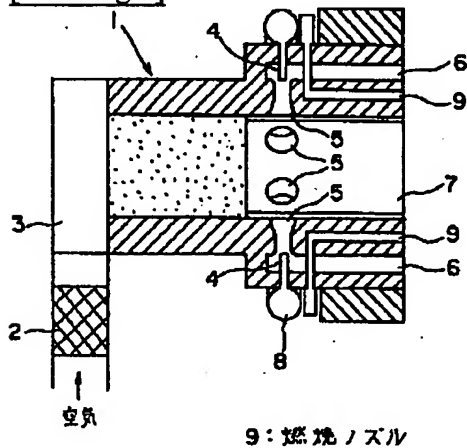
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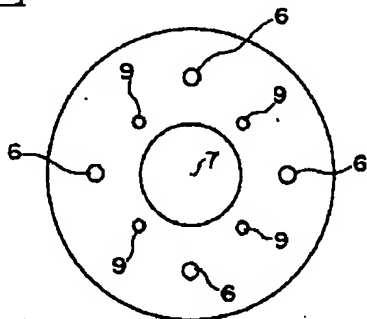
DRAWINGS

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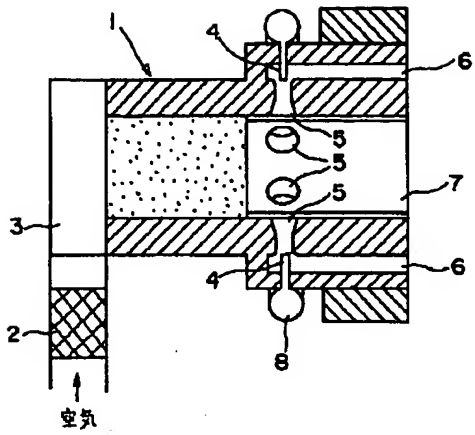
[Drawing 2]



[Drawing 3]

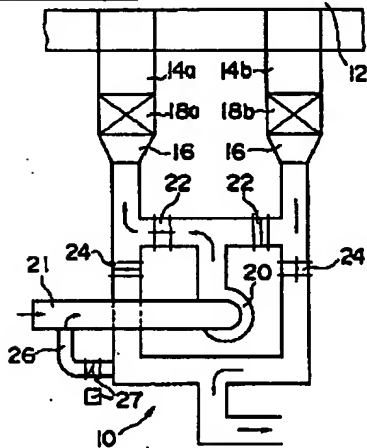


[Drawing 1]

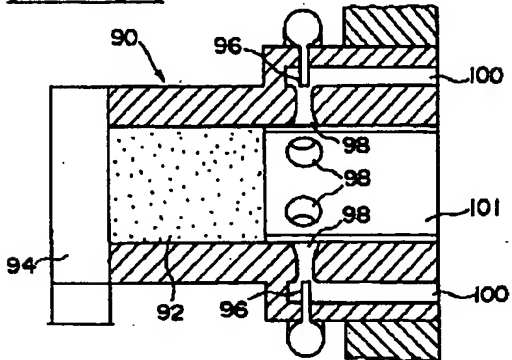


- 1: パーナ
- 2: 蓄熱体
- 3: 空気取入口
- 4: 燃料ノズル
- 5: ベンチュリー
- 6: 排ガス再循環ダクト
- 7: 開口
- 8: 蒸気管

[Drawing 4]



[Drawing 5]



[Translation done.]



## PATENT ABSTRACTS OF JAPAN

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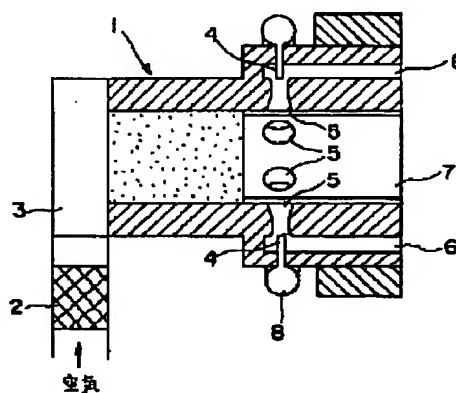
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(54) **HEAT STORAGE TYPE LOW-NOX BURNER**NO<sub>x</sub> can be facilitated.

(57) Abstract:

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**PURPOSE:** To enable suction of a large quantity of combustion exhaust gas in a heating furnace and thereby to enable attainment of low NO<sub>x</sub> by a method wherein the mixture of fuel and vapor is jetted from nozzles to venturi tubes of a burner part in a heat storage type burner.

**CONSTITUTION:** A heat storage type burner 1 is constructed to be in an exhaust gas recirculation system and supply of air for combustion from an air intake 3 and exhaust of a combustion exhaust gas are conducted through a heat storage body 2. The combustion exhaust gas in a heating furnace is sucked through recirculation ducts 6 and mixed in a burner part. In this case, venturi tubes 5 are attached to the burner part and nozzles 4 jetting the mixture of fuel and vapor to the venturi tubes 5 are disposed in this part. Moreover, the combustion exhaust gas in the heating furnace is sucked and made a driving source of the venturi tubes 5. In other words, a negative pressure is brought forth in the venturi tubes 5 with jetting from the nozzles 4 and thereby the combustion exhaust gas in the heating furnace is sucked through the exhaust gas recirculation ducts 6. According to this constitution, reduction of



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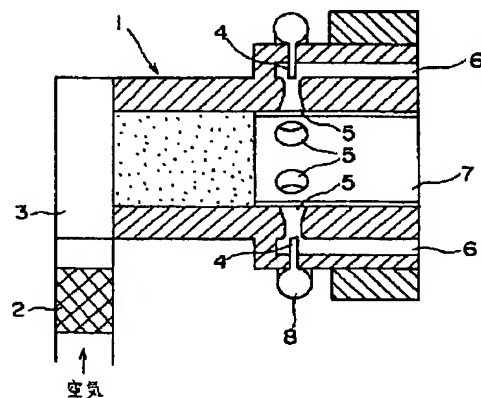
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(54)【発明の名称】 蓄熱式低NO<sub>x</sub>バーナ

(57)【要約】

【目的】 排出ガスのNO<sub>x</sub>濃度を基準値以下まで下げ得る直火式蓄熱低NO<sub>x</sub>バーナを提供する

【構成】 蓄熱体を通してバーナへの燃焼用空気の供給及びバーナからの燃焼ガスの排出を行う、一方、炉内の燃焼排ガスを排ガスダクトを経て吸引してバーナ部で混合させる排ガス再循環方式の蓄熱式バーナにおいて、1つはバーナ部にベンチュリーを設け、該ベンチュリーに燃料と蒸気との混合物を噴射するノズルを設け、炉内の燃焼排ガスを吸引しベンチュリーの駆動源とする蓄熱式低NO<sub>x</sub>バーナであり、2つはバーナ部にベンチュリーを設け、該ベンチュリーに蒸気のみを噴射するノズルを設け、該ベンチュリーにより炉内の燃焼排ガスを吸引しベンチュリーの駆動源とし、一方、燃焼ノズルをバーナの開口部の外円周側に設け、該燃焼ノズルを介して直接炉内に燃料を噴射する蓄熱式低NO<sub>x</sub>バーナである。



- 1: バーナ
- 2: 蓄熱体
- 3: 空気取入口
- 4: 燃料ノズル
- 5: ベンチュリー
- 6: 排ガス再循環ダクト
- 7: 開口
- 8: 蒸気管

## 【特許請求の範囲】

【請求項1】 蓄熱体を通してバーナへの燃焼用空気の供給及びバーナからの燃焼ガスの排出を行う、一方、炉内の燃焼排ガスを排ガスダクトを経て吸引してバーナ部で混合させる排ガス再循環方式の蓄熱式バーナにおいて、

バーナ部にベンチュリーを設け、該ベンチュリーに燃料と蒸気との混合物を噴射するノズルを設け、炉内の燃焼排ガスを吸引しベンチュリーの駆動源とすることを特徴とする蓄熱式低 $\text{NO}_x$ バーナ。

【請求項2】 蓄熱体を通してバーナへの燃焼用空気の供給及びバーナからの燃焼ガスの排出を行う、一方、炉内の燃焼排ガスを排ガスダクトを経て吸引してバーナ部で混合させる排ガス再循環方式の蓄熱式バーナにおいて、

バーナ部にベンチュリーを設け、該ベンチュリーに蒸気のみを噴射するノズルを設け、該ベンチュリーにより炉内の燃焼排ガスを吸引しベンチュリーの駆動源とし、一方、燃焼ノズルをバーナの開口部の外円周側に設け、該燃焼ノズルを介して直接炉内に燃料を噴射することを特徴とする蓄熱式低 $\text{NO}_x$ バーナ。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】 鉄鋼加熱炉等に用いられる蓄熱型交番燃焼システムに使用される低 $\text{NO}_x$ の排ガスを得る直火式蓄熱バーナに関するものである。

## 【0002】

【従来の技術】 近時、蓄熱式のバーナを用いた加熱炉が多く分野において用いられている。これらの加熱炉には排気ガスとして的高温燃焼排出物から熱を引出して蓄熱するための流入する燃焼空気を予熱するための熱の連続移動を伴う蓄熱ユニットが設けられている。

【0003】 従来からの上記の蓄熱システムについての問題点としては、 $\text{N}_2$ を結合した燃料を用いた場合と同様に、空気の極端な高温予熱と火炎温度の結果として生ずる燃焼排出物中に必然的に存在する極端に高い $\text{NO}_x$ 濃度がある。この結果、従来の蓄熱システムは、これら $\text{NO}_x$ の減少に適合出来ないもので新しい方法の開発が望まれていた。その1つとして特開平2-10002号公報には図4に示すような蓄熱システムを用いて $\text{NO}_x$ の生成を抑制する方法が開示されている。即ち、炉から出た排気ガスから交互に熱を引き出して、そこを通過する供給された燃焼空気を加熱するために設けられた蓄熱ベッドを有する型式の蓄熱バーナの一組において $\text{NO}_x$ の生成を抑制する方法であって、炉から高温排気ガスを引出し、ガス流を該排気ガス流に噴射し、該噴射されたガス流中に高温排気ガスの一部を随伴させ、噴射されたガス流と高温排気ガスの随伴部とをバーナ室に通過させ、バーナ室での燃焼プロセスを該高温排気ガス部分で混合し、これにより $\text{NO}_x$ の生成を抑制する方法である。

【0004】 図4において、この蓄熱システム10は離れた第1および第2蓄熱バーナ14a, 14bの一組を有し、各バーナ14a, 14bは、燃料と各バーナ14a, 14bに結合された蓄熱ベッド18a, 18bから供給された予熱燃焼空気流とを混合するための燃焼室12を有し、周期的に作動するように適合された各バーナ14a, 14bにおいて、排気ガス流が炉を出て第2バーナ14b室を通過し、該第2バーナ14bに接続された蓄熱ベッド18bに流れる間に、第1バーナ14aが高温ガスを炉内部に向ける燃焼状態にある型式の蓄熱バーナ装置である。尚、16は燃焼空気/排気通路、20は燃焼ブロワー、22は空気弁、24は排気弁、27は制御弁を示す。

【0005】 そして態様例として図5に示すようなバーナが開示されている。図5は $\text{NO}_x$ の生成を抑制する手段が、燃料ノズルと燃焼空気の一部を燃料ノズルに直接接するバーナの領域に導入する手段とを有し、更に燃焼空気の残余を燃料ノズルの上流へ導入する手段を備えたバーナを有するものである。このバーナにおいては、空気取入口94と蓄熱体92を備えたバーナ90に6個の燃料ノズル96、6個のベンチュリー98、6個の排ガス再循環ダクト100が取り付けられている。このバーナ90は開口101を通じて炉室に延びている。この求心的な配置の燃料ノズル96の全部によって、燃料はバーナ耐火物中のそれぞれの広がった円筒状の孔領域であるベンチュリー98を通じてバーナに供給される。燃料ノズル96からの高圧燃料の噴射はベンチュリー98に負圧領域を生じ、この負圧領域が炉ガスを炉室から混合ダクト100を通じて燃焼領域へ戻るように誘引するようになっている。要するに、この装置は、バーナ部にベンチュリー98を設置して、炉内の燃焼排ガスを吸引する際の駆動源として、燃料のみを用いる装置である。また、従来バーナにおいて、低 $\text{NO}_x$ 対策のためにバーナ中心部燃焼用空気側に、蒸気の噴射ノズルを設置し蒸気を噴射していた。

## 【0006】

【発明が解決しようとする課題】 以上述べた直火式蓄熱バーナを鋼材の加熱炉に用いた場合、炉内温度の最高は、1300℃程度となる。この条件で、低 $\text{NO}_x$ 対策を行わないと、排出ガスの $\text{NO}_x$ 濃度は1000ppm ( $\text{O}_2$ : 11%) 以上にもなる。従って、排出ガスの $\text{NO}_x$ 濃度を下げたため、排ガス再循環方式が開発され採用されてきた。しかしながら、この排ガス再循環方式の方法では、排出ガスの $\text{NO}_x$ 濃度は200ppm ( $\text{O}_2$ : 11%) 程度までにしか下がらず、日本国内のように、排出ガス $\text{NO}_x$ 基準濃度100ppm以下まで下げることが要求されている場合には、これを達成することは困難であるという問題点があった。この発明は、上記の問題点を解消出来るようにし、排出ガスの $\text{NO}_x$ 濃度を基準の100ppm以下まで下げ得る直火式蓄熱

低NO<sub>x</sub>バーナを提供することを目的としたものである。

#### 【0007】

【課題を解決するための手段】本発明は、炉内の燃焼排ガスをバーナ部で混合させる排ガス再循環方式の蓄熱式バーナにおいて、バーナ部にベンチュリーを設置して炉内の燃焼排ガスを吸引する際の駆動源として、燃料と蒸気との混合物或いは蒸気のみを用いることにより目的を達成したものである。即ち、第1発明は、蓄熱体を通してバーナへの燃焼用空気の供給及びバーナからの燃焼ガスの排出を行う、一方、炉内の燃焼排ガスを排ガスダクトを経て吸引してバーナ部で混合させる排ガス再循環方式の蓄熱式バーナにおいて、バーナ部にベンチュリーを設け、該ベンチュリーに燃料と蒸気との混合物を噴射するノズルを設け、炉内の燃焼排ガスを吸引するためベンチュリーの駆動源とすることを特徴とする蓄熱式低NO<sub>x</sub>バーナである。第2発明は、同上の排ガス再循環方式の蓄熱式バーナにおいて、バーナ部にベンチュリーを設け、該ベンチュリーに蒸気のみを噴射するノズルを設け、ベンチュリーの駆動源とし、該ベンチュリーにより炉内の燃焼排ガスを吸引し、一方、燃焼ノズルをバーナの開口部の外円周側に設け、該燃焼ノズルを介して直接炉内に燃料を噴射することを特徴とする蓄熱式低NO<sub>x</sub>バーナである。

#### 【0008】

【作用】直火式蓄熱バーナにおいて、排出ガスのNO<sub>x</sub>濃度を下げるためには、燃焼火炎の最高温度を下げる必要がある。このためには、従来方式に対し、より排ガス循環量を増加させる必要がある。これに対し、本発明の第1では、バーナ部にベンチュリーを設け、該ベンチュリーに燃料と蒸気との混合物を噴射するノズルを設け、燃料と蒸気との混合物をベンチュリーの駆動源として用いることにしたのでベンチュリー駆動用の流体の流量が増し、流速が増加することで、吸引力が増大して排ガス再循環量が増加した。さらに、同時に1600℃程度のバーナ火炎に比べ、遥かに温度の低い200℃程度の蒸気が燃料と一緒に噴射されることで火炎の最高温度部が、冷却され、1500℃以下まで温度が下がる。以上2つの作用により従来のNO<sub>x</sub>未対策時に比べ、バーナ排出ガスのNO<sub>x</sub>濃度が約1/10以下まで大幅に低下させることが出来る。

【0009】また、発明者らは、NO<sub>x</sub>濃度低減のための効果的な蒸気噴射方法として、数々の実験を行った結果、従来技術のように、燃焼用空気側に蒸気の噴射ノズルを設置する方法よりも、蒸気と燃料を均一混合して、火炎に噴射するほうが、効果のあることを知見した。この理由として、燃料が全て燃焼に寄与するため、噴射した蒸気が、火炎部に均一に行き渡り、火炎温度を効果的に下げることがあげられる。これに対し、燃焼用空気側に蒸気の噴射ノズルを設置した場合には、バーナに送ら

れた燃焼用空気が全て燃焼に寄与しないため、燃料と蒸気との混合物を用いた場合に比べ火炎温度が下がらずNO<sub>x</sub>濃度低減に効果的でない。また、燃料と蒸気との混合物を用いた場合には、燃料と蒸気が同一のノズルから吹き込まれるため、別々に、ノズルを設ける必要はないという利点もある。

【0010】更に、本発明の第2では、バーナ自体の緩慢燃焼により低NO<sub>x</sub>効果を持たせるため、燃料を直接炉内に吹き込むように燃料ノズルを配置されたバーナにおいて、更にNO<sub>x</sub>濃度を低下させるため、排ガス再循環用ベンチュリーの駆動用に燃料より圧力が高く、かつ火炎を冷却する効果の高い蒸気のみを用いることで、更に、火炎の最高温度部が、1450℃以下に冷却され、よりNO<sub>x</sub>濃度を低下させることが出来る。

#### 【0011】

【実施例】図1は、本発明の実施態様例である、蓄熱式低NO<sub>x</sub>バーナの側面図である。図1において、1はバーナ、2は蓄熱体、3は空気取り入れ口、4は燃料ノズル、5はベンチュリー、6再循環ダクト、7は開口、8は蒸気管である。本蓄熱式低NO<sub>x</sub>バーナにおいては、空気取入口3と蓄熱体2を備えたバーナ1には6個の燃料ノズル4、6個のベンチュリー5、6個の排ガス再循環ダクト6が取り付けられている。燃料ノズル4の元は、円周状のヘッダーになっており、ここに蒸気管8を付け、蒸気を導入し、燃料と均一混合する。6個の燃料ノズル4によって、燃料及び蒸気は、耐火物の開口7中のそれぞれのベンチュリー5と通じて、バーナに供給される。燃料ノズル4からの高圧で流量の多い燃料と蒸気の噴射は、ベンチュリー5に負圧領域を生じ、この負圧領域は、燃焼排ガスを炉内から排ガス再循環ダクト6を通じて、燃焼領域に戻るよう吸引する。

【0012】本蓄熱式低NO<sub>x</sub>バーナの場合、大量の燃焼排ガスの再循環噴射により燃焼火炎の最高温度が下げられる。本方式を最大燃焼量800000kcal/h容量の蓄熱式バーナに適用した場合、炉内温度1300℃の条件で、従来方式ではNO<sub>x</sub>が200ppm

(O<sub>2</sub>:11%)であったものが、燃料と混合して蒸気を8kg/h吹込むことにより、NO<sub>x</sub>濃度を80ppm(O<sub>2</sub>:11%)以下まで低減させることが出来た。

【0013】また、図2は、本発明の別の実施態様例である、蓄熱式低NO<sub>x</sub>バーナの側面図であり、図3は図2のVIII-VIII断面の正面図である。図において、9は燃焼ノズルである。他の符号は図1と同一であるので説明を省略する。この方式の蓄熱式低NO<sub>x</sub>バーナにおいては、燃料は6個の燃焼ノズル9によって、直接炉内に噴射させる。また、ベンチュリー5のノズル4には、蒸気のみを噴射させ、ベンチュリー5により負圧生成せしめ、燃焼排ガスを炉内から排ガス再循環ダクト6を通じて、燃焼領域に戻るよう吸引する。高圧(1kg/cm<sup>2</sup>)の蒸気をベンチュリー5の駆動源とすることで、

大量の燃焼排ガスの循環と蒸気の噴射により燃焼火炎の最高温度が下げられる。

【0014】本方式を最大燃焼量800000kcal/h容量のバーナに適用した場合、炉内温度1300℃の条件で、従来方式（排ガス循環を行わないもの）では、NO<sub>x</sub>が100ppm（O<sub>2</sub>：11%）であったものが、高圧（1kg/cm<sup>2</sup>）の蒸気を8kg/h吹込むことにより、NO<sub>x</sub>濃度を50ppm（O<sub>2</sub>：11%）以下まで低減させることが出来た。以上の結果、排出ガスのNO<sub>x</sub>濃度を50～80ppm（O<sub>2</sub>：11%）と、NO<sub>x</sub>の発生を大幅に低く抑えることが出来た。

【0015】なお、本発明に係る蓄熱式低NO<sub>x</sub>バーナは、上述した型式のバーナのものに限定されるものではなく、ラジアントチューブ式（間接加熱式）の自己排ガス再循環蓄熱バーナであれば、種々のタイプのバーナにて使用することが出来る。

【0016】

【発明の効果】本発明の蓄熱式低NO<sub>x</sub>バーナの採用により、鉄鋼加熱炉等の大量の排出ガスのNO<sub>x</sub>濃度を排出基準濃度以下の50～80ppm（O<sub>2</sub>：11%）に抑制することが出来、日本国内においても、この結果熱効率の良い直火蓄熱バーナを用いることが出来、生産性に寄与すること大である。

【図面の簡単な説明】

【図1】本発明の実施態様例である、蓄熱式低NO<sub>x</sub>バーナの側面図である。

【図2】本発明の別な実施態様例である、蓄熱式低NO<sub>x</sub>バーナの側面図である。

【図3】図3は図2のVIII-VIII断面の正面図である。

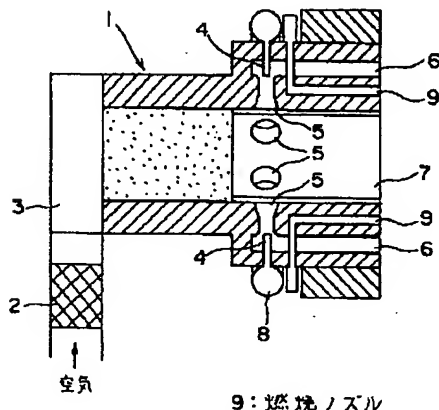
【図4】従来の蓄熱式バーナの側面の説明図である。

【図5】従来の蓄熱式バーナの側面の説明図である。

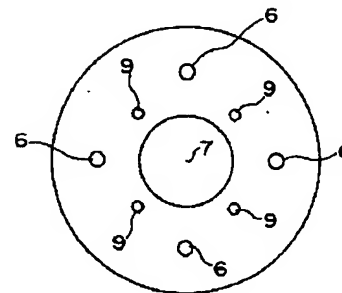
【符号の説明】

- 1 蓄熱式バーナ
- 2 蓄熱体
- 3 空気取入口
- 4 燃料ノズル
- 5 ベンチュリー
- 6 排ガス再循環ダクト
- 7 開口
- 8 蒸気管
- 9 燃焼ノズル
- 10 蓄熱システム
- 12 燃焼室
- 14 蓄熱バーナ
- 16 燃焼空気／排気通路
- 18 蓄熱ベッド
- 20 燃焼ブローワ
- 22 空気弁
- 24 排気弁
- 27 制御弁
- 90 バーナ
- 92 蓄熱ベッド
- 94 空気取入口
- 96 燃料ノズル
- 98 ベンチュリー
- 100 排ガス再循環ダクト
- 101 開口

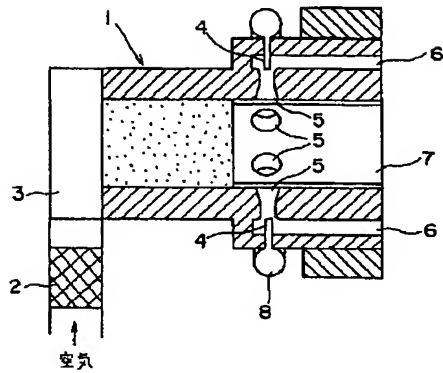
【図2】



【図3】

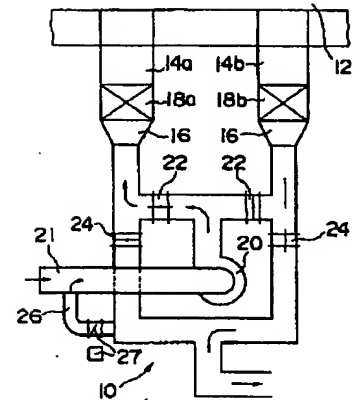


【図1】

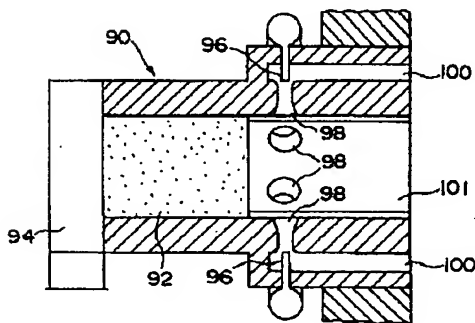


- 1: パーナ  
2: 蓄熱体  
3: 空気取入口  
4: 燃料ノズル  
5: ペンチュリー  
6: 排ガス再循環ダクト  
7: 開口  
8: 蒸気管

【図4】



【図5】



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